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PERFORMANCE EVALUATION OF THE NAVAL RESEARCH LABORATORY COAMPS ON THE FORECAST OF TYPHOON HERB IN THE WESTERN PACIFIC IN 1996

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1. INTRODUCTION

The Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) developed in the Marine Meteorology Division at the Naval Research Laboratory, was transitioned to Fleet Numerical Meteorological and Oceanographic Center (FNMOC) in September 1996, for evaluation as the next generation mesoscale forecast model for the Navy. The system allows multi-level grid nesting and has explicit treatment of precipitation and boundary layer effects to provide forecast of meso-alpha and meso-beta scale phenomena. The configuration of the system can cover a large domain with high resolution in the central region that is suitable for tropical cyclone forecasting such as the case presented here for Supertyphoon Herb that hit Taiwan island and caused severe damage. Performance of the COAMPS on the track forecast, wind and precipitation forecast, and interaction of the typhoon with topography is evaluated and analyzed.

2. SUPERTYPHOON HERB

Supertyphoon Herb had a history of 14 days from 21 July to 3 August, 1996 with a predominate movement to the west and northwest (Fig. 1). A maximum wind of 140 knots was estimated on 1800 UTC 30 July. The landfall of Herb over the northern part of Taiwan between 1200 UTC July 31 and 0000 1 August caused severe damage and took more than 50 lives. During that time, even though the Joint Typhoon Warning Center (JTWC) issued an official forecast fairly close to the best track, the objective aids provided diversified forecasts (Fig. 2). To study the forecast skill of COAMPS on detailed cyclone motion as well as its capability of a detailed forecast on the associated local wind and precipitation, the date on 0000 UTC 30 July is chosen for our experiment. After this initial time, Herb changed its course from northwest to west by northwest. Had it kept its northwest direction straight forward, it would have missed Taiwan.

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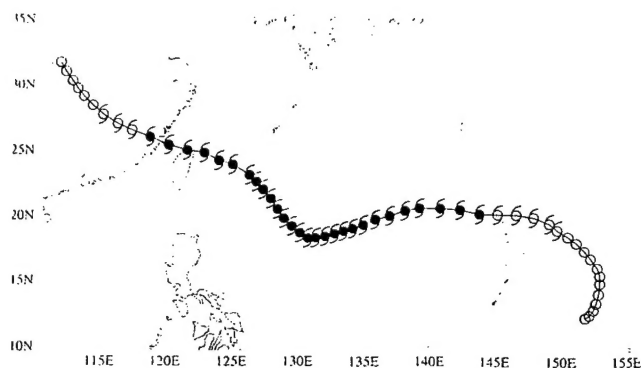


Fig. 1. Best track of Herb from the JTWC.

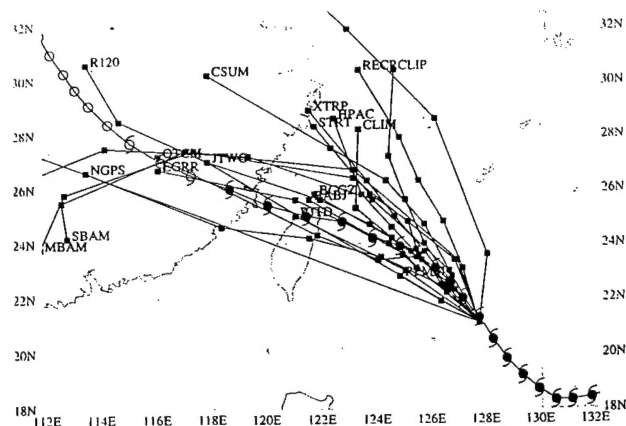


Fig. 2. Forecast tracks from all the objective aids at the JTWC on 0000 UTC 30 July.

3. MODEL CONFIGURATION

The COAMPS is a non-hydrostatic limited-area primitive equation model (Hodur 1997). The forecast of Herb uses a two-level nested grid with the outer grid size of 81 km and the inner grid size of 27 km. The outer domain covers a large area to capture the synoptic features while the inner domain covers Taiwan and its vicinity to allow proper interaction between the storm and Taiwan's steep topography. The array size for the

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outer domain is 111 by 77 and the inner one is 112 by 112. A total of 30 sigma levels are used in each mesh. COAMPS uses the Navy Operational Global Atmospheric prediction System (NOGAPS) analysis field as the first guess and then carries out its own optimal interpolation analysis on both grids. Since the NOGAPS contains a bogussing procedure for tropical cyclone (Goerss and Jeffries 1994), the initial wind field of COAMPS will have the bogus vortex built in already. The forecast is carried out to 48 h with the boundary conditions updated every 12 h from the NOGAPS forecast.

4. FORECAST VERIFICATION

The overall forecast of Herb is very good, with a distance error of 73 km at 24 h and 101 km at 48 h. Fig. 3 depicts the 48 h track forecast from the coarse grid compared with the best track. The track of the inner mesh domain is similar to the one from the outer domain, suggesting that increased resolution locally may not provide a significant difference on the track forecast because the track forecast relies heavily on the large-scale environmental flow.

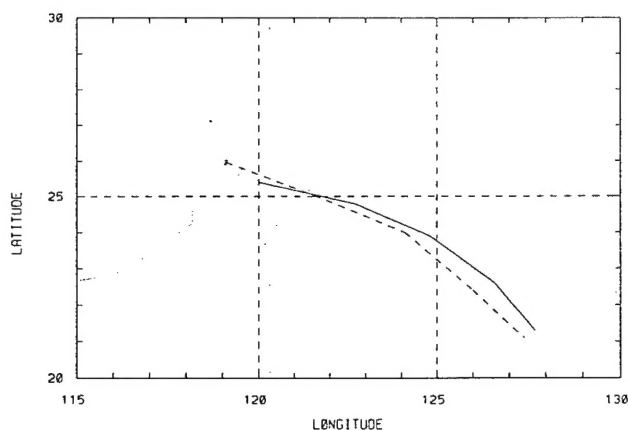


Fig. 3. Best track (solid line) and forecast track of the COAMPS for Herb on 0000 UTC 30 July.

To demonstrate the capability of forecasting local wind and precipitation, the 500 m wind isotach from the inner grid is depicted in Fig. 4a, and the subjective analysis of the Central Weather Bureau (CWB) in Taiwan using their dense observation network data on the island and surrounding small islands is given in Fig. 4b. The three local wind maximum regions are well-captured by the COAMPS, one to the north of the storm center, one off the southeast coast of Taiwan and the third one in the Taiwan Strait.

The forecast from the triple-nested model with the inner grid size equal to 9 km will be analyzed and reported.

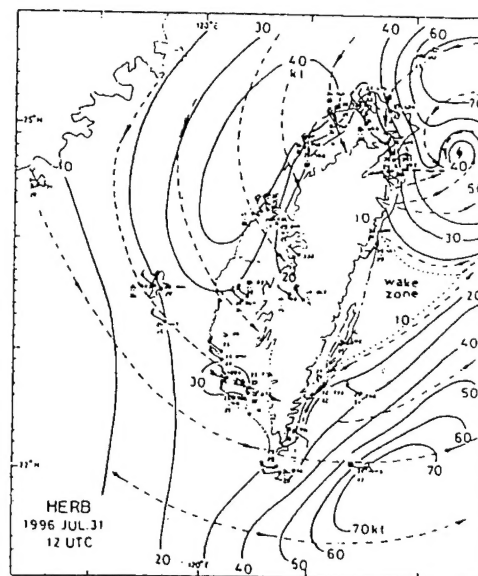
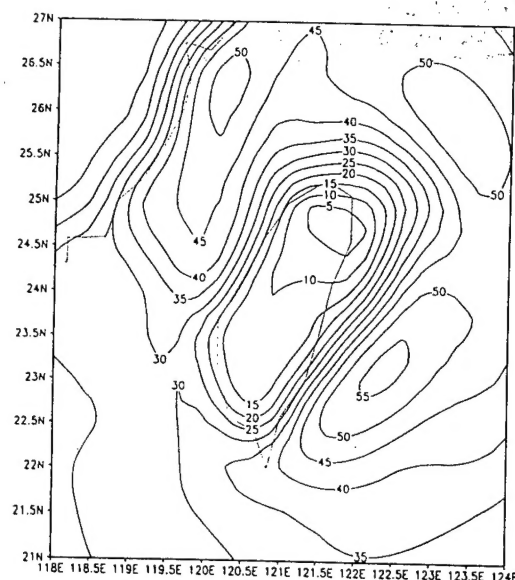


Fig. 4 a) Isotachs at 500 m height level from the 36 h forecast ;b) verification of it from the CWB subjective analysis.

References

- Goerss, J. S. and R. A. Jeffries, 1994: Assimilation of synthetic tropical cyclone observations into the Navy Operational Atmospheric Prediction System. *Wea. And Forecasting*, **9**, 557-576.
- Hodur, R., 1997: The Naval Research Laboratory's Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS). To be appear in July 1997 *Mon. Wea. Rev.*